

## Description

# [BUTTON STRUCTURE AND DESIGN METHOD FOR LATCHING PREVENTION]

### CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the priority benefit of Taiwan application serial no.91118156, filed on Aug. 13, 2002.

### BACKGROUND OF INVENTION

[0002] Field of Invention

[0003] The present invention relates to a button structure and design method. More particularly, the present invention relates to a button structure and design method for preventing the latching of buttons.

[0004] Description of Related Art

[0005] Keyboard provides an essential communication interface between users and their electronic products. As the need for electronic products continues to increase, different types of key button structures and design methods are also developed. If, for whatever reason, the button is mo-

mentarily latched when the button is pressed, smoothness of the keying operation is affected. Therefore, providing a latch-free button structure and design method is critical to the keyboard operation.

[0006] Figs. 1A and 1B are schematic views showing the configuration of one of the buttons inside a conventional electronic product before and after the button is pressed. As shown in Fig. 1A, the electronic product 10 includes at least a housing 20, a plurality of buttons 30 (only one is shown) and a printed circuit board (PCB) 40. The button 30 comprises a cap body 32 and a contact rod 34 attached to the bottom section of the cap body 32. The circuit board 40 is placed inside the housing 20 and the button 30 is positioned between the housing 20 and the circuit board 40. The upper section of the cap body 32 is exposed to the top through the housing 20. Through the pressing action provided by a user, the contact rod 34 underneath the button 30 touches an electrical contact 42 on the circuit board 40 leading to electrical conduction.

[0007] As shown in Fig. 1B, dimensional tolerance of the buttons 30 in most electronic products 10 is generally loose. When a user presses on the cap body 32 of the button 30 so that the contact rod 34 touches the contact point 42 on

the circuit board 40, the cap body 32 may deform momentarily and press against the sides of the housing 20. If point a of the cap body 32 is pushed below point c or point a is caught between point b and point c of the sidewall 22 of the housing (as shown in Fig. 1B), the cap body 32 is easily latched to the sidewall 22. As a result, the button 30 has difficulties returning to its original position after the pressure on the button 30 is released leading to a slowdown of typing.

## **SUMMARY OF INVENTION**

[0008] Accordingly, one object of the present invention is to provide a button structure and design method capable of preventing the latching of buttons. By design, the button body, the housing, the button cover and the circuit board all have precise dimensional relationship with each other so that a button structure fabricated according to this dimensional relationship is latch-free.

[0009] To achieve these and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, the invention provides a button structure and its design method for preventing latching. The button structure can be applied to many types of electronic products includes cellular phone, personal digi-

tal assistant (PDA), scanners and calculators. A button is positioned between a button cover and a housing directly above an electrical contact on a printed circuit board. The button includes a body, a wing plate, a positioning plate and a contact rod. The side edge of the button body and the top end of the wing plate are joined together. The positioning plate joins to the bottom end of the wing plate. The contact rod is attached to the bottom section of the button body. Assume height from the bottom of the contact rod to the contact point on the circuit board is B; height from the bottom section of the button body to the surface of the housing is C; height of the wing plate is A; height of the sidewall of the button cover close to the button body is D and height from the uppermost section of the button body to the top end of the wing plate is E. The dimensions A, B, C, D and E must follow the inequality relationships  $E-B>D$ ,  $E-D>A$  and  $D>A\geq C\geq B$ .

[0010] Thus, as long as various components of the button structure are fabricated according to the aforementioned design dimensions, the button is able to travel down and touch the contact point on the circuit board. In addition, the highest point on the side edges of the button body will not drop below the highest point on the sidewall of

the button cover next to the button body. Hence, one direct cause of latching is eliminated so that the button may smoothly return to its original position once the pressure is released.

[0011] It is to be understood that both the foregoing general description and the following detailed description are exemplary, and are intended to provide further explanation of the invention as claimed.

#### **BRIEF DESCRIPTION OF DRAWINGS**

[0012] The accompanying drawings are included to provide a further understanding of the invention, and are incorporated in and constitute a part of this specification. The drawings illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

[0013] Figs. 1A and 1B are schematic views showing the configuration of one of the buttons inside a conventional electronic product before and after the button is pressed.

[0014] Figs. 2A and 2B are schematic views showing the structure of a button and the configuration before and after the button is pressed according to one preferred embodiment of this invention.

#### **DETAILED DESCRIPTION**

[0015] Reference will now be made in detail to the present preferred embodiments of the invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers are used in the drawings and the description to refer to the same or like parts.

[0016] Fig. 2A is a cross-sectional view of a button structure for an electronic product and the configuration before the button is pressed according to one preferred embodiment of this invention. As shown in Fig. 2A, the electronic product 100 includes at least a housing 110, a plurality of buttons 120 (only one button is shown), a button cover 130 and a circuit board 140. The circuit board 140 is enclosed inside the housing 110 and the button 120 is positioned between the button cover 130 and the housing 110. The button 120 comprises a body 122, a wing plate 124, a positioning plate 126 and a contact rod 128. The wing plate 124 has an outward-arching sectional profile. The side edges of the button body 122 and the upper end of the wing plate 124 are joined together. The positioning plate 126 lying flat on the outer surface of the housing 110 joins with the lower end of the wing plate 124. The contact rod 128 is attached to the bottom section of the

button body 122. Various components constituting the aforementioned button 120 may be manufactured together as an integrative unit (as shown in Fig. 2A). Alternatively, the button body 122 and the contact rod 128 are individually manufactured and then assembled together thereafter.

[0017] Assume height from the bottom of the contact rod 128 to the contact point 142 on the circuit board 140 is B; height from the bottom section of the button body 122 to the surface 112 of the housing 110 is C; height of the wing plate 124 is A; height of the sidewall 132 of the button cover 130 close to the button body 122 is D and height from the uppermost section of the button body 122 to the top end of the wing plate 124 is E. The dimensions A, B, C, D and E must follow the inequality relationships  $E-B>D$ ,  $E-D>A$  and  $D>A\geq C\geq B$ .

[0018] Fig. 2B is a cross-sectional view of a button structure for an electronic product and the configuration after the button is pressed according to one preferred embodiment of this invention. When a user presses the top of the button 120, the button body 122 and the contact rod 128 underneath travels downward until the contact rod 128 touches the contact point 142 on the circuit board 140 and con-

ducts electricity. In the meantime, the wing plate 124 attached to the side edge of the button body 122 will deform while the button body 122 moves down.

- [0019] When the user releases the pressure on the button 120, the button body 122 will return to its original position because the deformed wing plate 124 stores up some elastic energy.
- [0020] As shown in Figs. 2A and 2B, the button 120, the housing 10, the button cover 130 and the circuit board 140 all have some dimensional regulations (that is,  $E-B>D$ ,  $E-D>A$  and  $D>A\geq C\geq B$ ). When the contact rod 128 is in contact with the contact point 142 on the circuit board 140, the downward distance moved by the bottom section of the contact rod 128 towards the contact point 142 is the height B. At this moment, the highest point  $a'$  at the side of the button body 122 also moves downward by the height B. Since it has a height limitation from the top of the button body 122 to the height E for the top of the wing plate 124 ( $E-B>D$ ), when the point  $a'$  moves downward by the height B, the point  $a'$  will lower than the point  $b'$ , resulting in the increase of probability to press the button. Therefore, the condition of  $E-B>D$  is a necessary condition.

[0021] When the contact rod 128 is in contact with the contact point 142 on the circuit board 140 and moves downward by the height B, the bottom section of the button body 122 also moves downward by the height B at the same time. Since the distance from the bottom section of the button body 122 to the surface 112 of the housing 110 is the height C and  $C \geq B$ , the distance from the bottom section of the button body 122 to the surface 112 of the housing 110 will reduce to  $C'$  ( $C' = C - B$ , when  $C > B$ ) or zero (when  $C = B$ ) when the contact rod 128 touches the contact point 142 on the circuit board 140. By a reverse argument from such a dimensional relationship, if the height  $C < B$ , the contact rod 128 only has to travel a distance C before the bottom section of the button body 122 and the surface 112 of the housing 110 are in contact. Hence, the contact rod 128 is prevented from moving further down to contact the contact point 142 on the circuit board 140. Under such circumstances, electrical conduction by the contact rod 128 is prevented. Hence, the relationship: height of  $C \geq$  height of  $B$  is a first condition.

[0022] When the bottom section of the button body 122 moves down to the height C, the deformation in the wing plate

124 is also the height C. Since the height A of the wing plate 124 is greater or equal to the height C, that is, the height  $A \geq$  the height C, the height of the wing plate 124 is reduced to  $A'$  (where  $A' = A - C$  when  $A > C$ ) or zero (when  $A = C$ ). By a reverse argument from such a dimensional relationship, if the height A < the height C, the bottom section of the button body 122 only has to move downward by a distance C before the deformation of the wing plate 124 exceeds the height A of the wing plate 124. Thereafter, the wing plate 124 will start to cave in. Thus, the wing plate 124 is likely to stay deformed instead of returning to its former configuration leading to a higher probability of latching. Hence, the relationship: height of A  $\geq$  height of C is a second condition.

[0023] If the height of deformation of the downward moving wing plate 124 is A and the downward movement of point a' is also the height A and assume that the point a' at the top of the button body 122 has a height equal to the point b' on the sidewall 132 of the button cover 130, the point a' will not be lower than the point c' because the height D > the height A. By a reverse argument, if the height D < the height A, as the point a' moves downward along with the wing plate 124 a distance equal to the height A, the dis-

tance  $a'$  traveled will exceed the height  $D$  of the sidewall 132 and stay below the point  $c'$ . As this will increase latching probability, the relationship: height of  $D >$  height of  $A$  is a third condition.

[0024] If the point  $a'$  at the top of the button body 122 moves down a distance equal to the height  $A$  along with the wing plate 124, the point  $a'$  will not drop below the point  $b'$  because the height  $E$  (from the top of the button body 122 to the top end of the wing plate 124) is regulated by the relationship  $E - D > A$ . By a reverse argument, if  $E - D > A$  holds, as soon as the point  $a'$  moves down by a distance equal to the height  $A$  along with the wing plate 124, the point  $a'$  has dropped below the point  $b'$ . As this will increase latching probability, the relationship: the height  $E - D >$  the height of  $A$  is a fourth condition.

[0025] In conclusion, this invention provides a means of reducing the latching of buttons as long as various components constituting the button structure adheres to the aforementioned dimensional relationships (that is,  $E - B > D$ ,  $E - D > A$  and  $D > A \geq C \geq B$ ). When the button fabricated according to this invention is pressed, the highest point on the side edge of the button body will not drop below the highest point on the sidewall of the button cover next to

the button body. In other words, latching of the buttons is prevented and hence any electronic product having the button structure can operate smoothly.

- [0026] Basically, the foregoing parameters A, B, C, D, E are set to have the relation of  $E-B > D$ . Further still, the additional condition can be added by  $E-D > A$ ,  $D > A$ ,  $A \geq C$ ,  $A \geq B$ , or  $C \geq B$ .
- [0027] It will be apparent to those skilled in the art that various modifications and variations can be made to the structure of the present invention without departing from the scope or spirit of the invention. In view of the foregoing, it is intended that the present invention cover modifications and variations of this invention provided they fall within the scope of the following claims and their equivalents.